

CLAIMS

What is claimed is:

1. A mucosal DTPa vaccine comprising:
 - (a) a diphtheria antigen, a tetanus antigen, and an acellular pertussis antigen; and
 - (b) a detoxified *E. coli* LT-K63 and LT-R72 mutant, wherein said vaccine is administered mucosally.
2. The DTPa vaccine of claim 1, wherein the acellular pertussis antigen is detoxified.
3. The DTPa vaccine of claim 2, wherein the acellular pertussis antigen comprises detoxified pertussis holotoxin and filamentous haemagglutinin.
4. The DTPa vaccine of claim 3, wherein the acellular pertussis antigen further comprises pertactin.
5. The DTPa vaccine of claim 3, wherein the detoxified pertussis holotoxin is a 9K/129G double mutant.
6. The DTPa vaccine of claim 1, wherein the diphtheria antigen is detoxified.
7. The DTPa vaccine of claim 6, wherein the detoxified diphtheria antigen is CRM197.
8. The DTPa vaccine of claim 1, wherein the tetanus antigen is a tetanus toxoid.
9. The DTPa vaccine of claim 1, further comprising at least one additional non-DTP antigen.

10. The DTPa vaccine of claim 1, wherein said vaccine is administered intranasally.

11. A mucosal DTPa vaccine comprising:

(a) a diphtheria antigen, a tetanus antigen, and an acellular pertussis antigen, wherein the acellular pertussis antigen is a detoxified pertussis holotoxin; and

(b) a detoxified form of either cholera toxin or *E. coli* heat labile toxin, wherein said vaccine is administered mucosally.

12. The DTPa vaccine of claim 11, wherein the detoxified pertussis holotoxin is a 9K/129G double mutant.

13. The DTPa vaccine of claim 11, wherein the acellular pertussis antigen further comprises filamentous haemagglutinin.

14. The DTPa vaccine of claim 13, wherein the acellular pertussis antigen further comprises pertactin.

15. The DTPa vaccine of claim 11, wherein (b) is LT-K63 or LT-R72.

16. The DTPa vaccine of claim 11, wherein the diphtheria antigen is detoxified.

17. The DTPa vaccine of claim 16, wherein the detoxified diphtheria antigen is CRM197.

18. The DTPa vaccine of claim 11, wherein the tetanus antigen is a tetanus toxoid.

19. The DTPa vaccine of claim 11, further comprising at least one additional non-DTP antigen.

20. The DTPa vaccine of claim 11, wherein said vaccine is administered intranasally.

21. A method of generating an immune response in a patient, comprising mucosally administering to the patient a vaccine according to claim 1.

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22. The method of claim 21, wherein the patient is a child.

23. The method of claim 21, wherein mucosal administration is performed at least twice.

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24. The method of claim 21, wherein, prior to mucosal administration, the method comprises the step of non-mucosally administering to the patient a DTPa vaccine.

25. The method of claim 21, wherein, subsequent to mucosal administration, the method comprises the step of non-mucosally administering to the patient a DTPa vaccine.

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26. The method of claim 21, wherein the administering is intranasal.

27. The method of claim 21, wherein an immune response is generated against whooping cough, diphtheria and tetanus.

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28. A method of generating an immune response in a patient, comprising mucosally administering to the patient a vaccine according to claim 11.

29. The method of claim 28, wherein the patient is a child.

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30. The method of claim 28, wherein mucosal administration is performed at least twice.

31. The method of claim 28, wherein, prior to mucosal administration, the method comprises the step of non-mucosally administering to the patient a DTPa vaccine.

5 32. The method of claim 28, wherein, subsequent to mucosal administration, the method comprises the step of non-mucosally administering to the patient a DTPa vaccine.

33. The method of claim 28, wherein the administering is intranasal.

10 34. The method of claim 28, wherein an immune response is generated against whooping cough, diphtheria and tetanus.